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S. N. BUCHANAN
ELECTRICAL CONNECTOR
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2,383,909

Fig. 1.

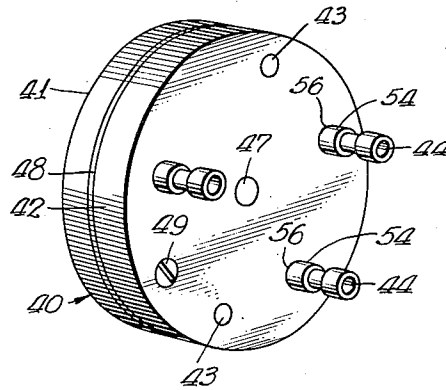


Fig. 2.

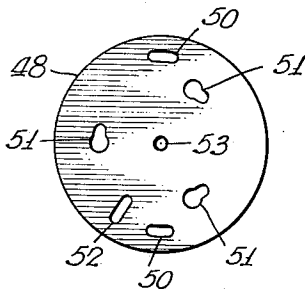


Fig. 3.

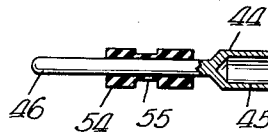


Fig. 6.

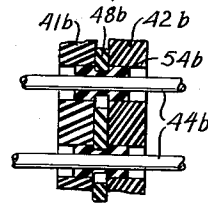


Fig. 4.



Fig. 5.

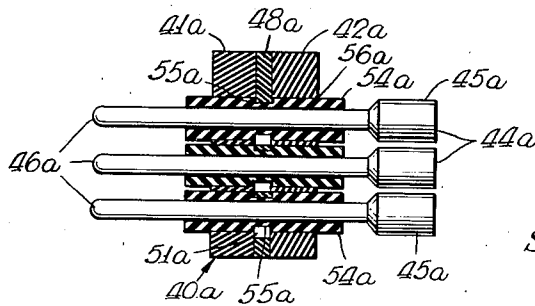
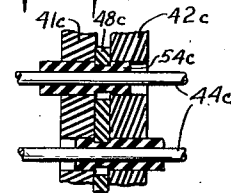


Fig. 7.



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ELECTRICAL CONNECTOR

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Aircraft-Marine Products, Inc., Elizabeth, N. J.,
a corporation of New Jersey

Application November 14, 1942, Serial No. 465,545

9 Claims. (Cl. 173—361)

This invention relates to electrical connectors and, more specifically, to a connector plug assembly adapted to connect simultaneously a plurality of electrical conductors in a compact and practical manner or to lead them through a partition, bulkhead, or the like. The invention also relates to connector pins for use in such plugs.

There are many instances where a plurality of electrical conductors must be connected or brought through a partition, pressure-tight bulkhead, or the like, within a restricted area. The wiring for an ordinary instrument panel and its associated parts is an example. The electrical control apparatus of airplanes and of naval vessels and radio and telephone circuits afford others. Attempts have been made heretofore to provide multiple contact plugs for these purposes and plugs directed toward these ends are now available. In a copending application of Vernon E. Carlson, Serial No. 465,547, filed herewith, there is shown a multiple plug which permits one to insert, remove, or replace individual connectors in the plug after it is made. Such a structure removes the necessity for clearances between the individual connectors which are necessary when one has to solder the electrical conductors to the connectors while in the plug. This permits more connectors to be crowded into a given plug area; but this advantage soon comes to a new limit in the fact that the individual connectors, where they pass through the plug, have to be spaced from one another sufficiently far apart to prevent electrical creepage across the surfaces of the plug from one connector to another. The spacing necessary in a given plug or socket has depended upon the current and voltage requirements, the dimensions of the individual conductors, and the materials used.

It had been proposed prior to this invention to increase the creepage distance between adjacent connections. Such structure as was known, however, is of no avail where a locking slide is used, as in said copending application of Vernon E. Carlson, since the creepage distance will always be the minimum distance along the surface of the slide. The present invention gives for the first time a practical multiple plug assembly susceptible of mass production in which the individual connectors can be spaced more closely than the permitted creepage distance.

It is an object of this invention to provide an improved multiple pin electrical connecting means. A further object is the provision of means for enabling electrical conductors to be connected in a compact manner through a partition.

A still further object is the provision of improved means for locking a plurality of electrical conductors into a multiple plug or socket. Another object is to provide insulating means in a multiple pin plug or socket to give a more compact multiple pin connector than has heretofore been feasible for a given number of connectors. Other objects will be in part pointed out as the description proceeds and will in part become apparent therefrom.

The invention is made possible through the combination of a plurality of removable pins, each adapted to be fastened to an electrical conductor, with a plug adapted for reception of said pins in spaced relation, and with insulating means by which the pins may be locked into the plug. More particularly, it has been discovered that by forming the lock portions of the pins in insulating sleeves carried on the pins where they fit through the plug, the pins can be positioned more compactly than was possible heretofore because of the increase in the electrical creepage distance effected by the sleeves. In this respect the invention is an improvement upon said invention of Vernon E. Carlson, Serial No. 465,547, filed herewith.

In this specification and in the accompanying drawing, I have shown and described a preferred embodiment of my invention and various modifications thereof. But it is to be understood that these are not intended to be exhaustive nor limiting of the invention, but, on the contrary, are given for purposes of illustration in order that others skilled in the art may fully understand the invention and its principles and the manner of applying it in practical use so that they may modify and adapt it in various forms, each as may be best suited to the conditions of a particular use.

In the drawing, in which like reference characters refer to like parts throughout and in which exemplary embodiments for attaining the above objectives are set forth:

Figure 1 is an enlarged perspective view of one type of connector plug embodying the invention;

Figure 2 is a plan view of the locking means used in the plug illustrated in Figure 1.

Figure 3 is a longitudinal elevation, partially in section, of a terminal pin of the type used with the plug illustrated in Figure 1;

Figure 4 is a perspective view of an eccentric used in the plug illustrated in Figure 1;

Figure 5 is a sectional view taken through a plug similar to that shown in Figure 1 but showing a modification thereof;

Figure 6 is a sectional view similar to that of Figure 5 showing an additional modification; and Figure 7 is a sectional view similar to that of Figure 6 showing a further modification.

Referring to Figure 1, a plug indicated generally by 40 is illustrated. For a more complete showing of one of the manners of using a plug of this type reference may be had to the aforementioned application of Vernon E. Carlson or the application of Harry B. White, Serial No. 465,546, filed herewith. Plug 40 comprises socket plate 41, socket plate 42, and a locking means 48 therebetween. In the present embodiment locking means 48 consists of an insulating plate, illustrated in greater detail in Figure 2, which engages in grooved insulating sleeves 54 on the contact pin 44 (Figure 3).

Plates 41, 42, and 48 may be made of Bakelite or other phenolic resin, vulcanized fiber or other insulating material. Plates 41 and 42 are held in assembled relationship by clamping means 43 comprising in the present embodiment a conventional rivet construction. Locking plate 48 is slidably mounted between plates 41 and 42, in this instance being rotatable about a bearing rivet 47 fitted through a bearing hole 53 in plate 48 (see Figure 2). Plate 48 is provided with arcuate slots 50 through which rivets 43 extend and which allow for rotation of plate 48 about bearing 47 and with respect to plates 41 and 42.

Plate 48 may be moved with respect to plates 41 and 42 by any suitable means, advantageously in the case illustrated by means of an eccentric 49 (see Figure 4). Eccentric 49 is threaded into and rotatable in plate 42, and the eccentric portion is received in a radial slot 52 of plate 48. The end of the eccentric is provided with a kerf for reception of a screw driver blade by which it may be turned to rotate the locking plate. Socket plates 41 and 42 carry aligned openings 56 adapted to receive pins 44 (Figure 3), as indicated in Figure 1. Also in alignment with openings 56 are keyhole slots 51 in plate 48.

As plate 48 is rotated with respect to plates 41 and 42, the keyhole slots 51 are moved with respect to openings 56. In one extreme position of eccentric 49, the larger portions of keyhole slots 51 are in alignment with openings 56 and in the other extreme position of the eccentric the smaller portions of the keyhole slots are coaxial with the openings 56.

Instead of a rotary locking plate, this plate may be slidable laterally with respect to the socket plates and in such case, a part of the locking plate may advantageously project beyond the socket plates in the open position so that the plug cannot be inserted into a receptacle until the contact pins are locked in place by sliding the locking plate to locking position. Such a plug is shown in Figure 5 where, in the position shown, the pins 44a are locked within plug 40a. Plate 48a is arranged to be moved vertically, as shown in Figure 5, to release the pins from the socket plates.

Figure 3 illustrates one of the terminal connectors or pins 44. Pin 44 is provided with a ferrule end 45, a lock portion 55 and a contact end 46. Ferrule end 45 is in this case of a type used in making a solderless connection with an electrical conductor. Usually such a connection is made by a crimping operation. In the broadest aspect of the present invention the connection might be soldered or brazed or connected in any other manner known for connecting conductors to terminals. Lock portion 55 com-

prises a circumferentially grooved insulating sleeve 54 which covers the central portion of the pin and which will be described in more detail hereinafter. Contact end 46 is proportioned to extend through the plug and may be either male of female, depending upon the installation at hand.

Sleeve 54 consists of an insulating material, such as Bakelite, and preferably is permanently molded or cemented or shrunk in place along the central portion of the pin. This central portion is shown of reduced diameter to assist in holding the sleeve securely in its proper position; knurling or other surface treatment may be used likewise to anchor the sleeve to the pin. These expedients, however, are not essential.

This sleeve is somewhat longer than the width of the plug with which it is to be used and its length is so related to the groove 55 that, when a pin is locked in position in the plug, the insulating sleeve will project on either side of the plug beyond the faces thereof, as illustrated in Figures 1 and 5. By this arrangement the creepage distance is no longer the distance between the pins 44 on the surface or the plates 41 or 42 nor on the surface of the locking slide 48, but instead is the sum of the spacing on the surface of the plates plus the distances to the ends of the sleeves 54 plus the thicknesses of the sleeves. Since sleeves 54 also carry the circular grooves 55 which form the lock portions for the connector pins, the pins are fully insulated against direct creepage along the surface of the locking slide plate 48.

Although I have used the sleeves 54 to increase the creepage distance both at the outer surfaces of plates 41 and 42 and at the inner faces between these and the locking plate 48, only the latter is necessary and if it is desired, the outer surfaces may be treated with annular corrugations or otherwise as previously known for simple molded plugs. Also it will be understood that my invention may be utilized at these surfaces by terminating the sleeves 54 short of the outer surfaces of plates 41 and 42 instead of extending them beyond said surfaces, and keeping the opening of larger diameters, beyond the end of the sleeves, than the corresponding portions of the pin, so that there can be no direct creepage between pins over the outer surfaces of the plates. Figures 6 and 7 illustrate examples of such arrangements.

Hence, the insulating sleeves at the same time serve both to lock the pins in the socket and to increase the creepage distances between the pins. The advantages of this double function are twofold. The locking feature allows the pins to be permanently attached to the electrical connectors under ideal working conditions before being assembled through the plug. Thus, no space need be provided at the plug to allow for making soldered or crimped connections. At the same time the increased creepage distance afforded by the sleeves allows full advantage to be taken of the compact assembly enabled by the locking feature without danger of electrical breakdown from short circuits or current losses between adjacent pins.

It will be understood, of course, that the showing of only two or three pins in the drawing and the exaggeration of dimensions of the sleeve 54 and groove 55 and of various other parts are for clearer illustration. In practice the pins may be more numerous and more closely spaced and the sleeves may be much thinner if good in

lating material is used and high voltages are not to be encountered.

Thus, the invention provides in a practical manner for electrical conductors to be connected through a partition permanently, tightly, and compactly without the limitations inherent in earlier connections known in the prior art.

As various modifications and changes might be made in the invention as set forth, and as different designs thereof will be necessitated by the many applications to which it may be put, patent protection is not intended to be limited to the embodiments described and illustrated. The scope of the invention on the contrary is intended to be limited solely by the accompanying claims.

I claim:

1. In an electrical connection of the type having a plug and a contact pin therefor and means operable within the plug for locking the pin in the plug; an insulating sleeve surrounding said pin and extending at each end thereof to a position substantially spaced from the plane of any transverse surface of said plug and having a lock portion, and said plug including an opening fitted to said pin and having a locking means to engage the lock portion of the sleeve of the pin in the opening, whereby said pin may be locked in said plug when it is inserted into the opening.

2. In an electrical connection, a plug and a contact pin therefor; said pin including an insulating sleeve having a lock portion and said plug including an opening fitted to said pin and having a locking means to engage the lock portion of the sleeve of the pin in the opening, whereby said pin may be locked in said plug when it is inserted into the opening; the length of said sleeve on each side of said lock portion being other than the distance from said locking means to the surface of any lamina of said plug, whereby the creepage distance between said pin and any other pin which may be in said plug is increased over the spacing distance between said pin and said other pin.

3. In an electrical connection, a contact pin and a plug including an insulating support; said pin including a ferrule end, a contact end, and an intermediate insulated lock portion having insulation extending beyond the lock portion on each side thereof along the pin and terminating in offset relationship with respect to any transverse surface of the plug, and said insulating support including an opening fitted to said pin and having locking means associated with said opening, whereby the pin may be inserted into the support after its ferrule has been secured to an electrical conductor and thereafter locked in assembled relationship with the ferrule end on one side of the insulating support and the contact end projecting on the other.

4. The combination with a multiple pin type plug having, a plurality of pin type terminal con-

tact members, a receptacle for said contact members, and a locking means therefor, said contact members each including a contact end adapted to project through the receptacle, a ferrule end adapted to make a good electrical connection with an electrical conductor, and an intermediate portion adapted to lie within the locking means; of insulating sleeves over said intermediate portions of said contact pins adapted to extend on each side of said locking means and to terminate in offset relationship with respect to any transverse surface of said plug, whereby each terminal contact member may be connected to an electrical conductor before being positioned in the receptacle and thereafter may be locked in the receptacle in close juxtaposition adjacent one another with creepage distances greater than their spacings.

5. In an electrical connection, a plug and a contact pin therefor; said pin including an insulating sleeve having a lock portion and said plug including an opening fitted to said pin and having a locking means in the plug to engage the lock portion of the sleeve of the pin in the opening, whereby said pin may be locked in said plug when it is inserted into the opening, said insulating sleeve being of such length that the end faces of said sleeve do not coincide with the faces of said plug, whereby the creepage distance between said pin and any other pin in said plug is increased over the straight line distance between said pins.

6. In an electrical connection, a plug and a contact pin therefor; said pin including an insulating sleeve having a recessed lock portion and said plug including an opening fitted to said pin and a slidable plate intercepting said opening and adapted in one position thereof to project into said opening to engage in the recessed lock portion of said sleeve, whereby it may be locked in assembled relationship, and in another position to be withdrawn from said opening to permit insertion and removal of said pin, said insulating sleeve being of such length that the end faces of said sleeve do not coincide with either the outer surfaces of the faces of said plug or the faces of said slidable plate, whereby the creepage distance between said pin and any other pin in said plug is increased over the straight line distance between said pin and said other pin.

7. The invention of claim 5 wherein the end faces of said sleeve extend beyond the faces of said plug.

8. The invention of claim 5 wherein the end faces of said sleeve are countersunk with respect to the faces of said plug.

9. The invention of claim 5 wherein one of the end faces of said sleeve extends beyond the adjacent face of said plug and the other end face of said sleeve is countersunk with respect to its adjacent face of said plug.

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